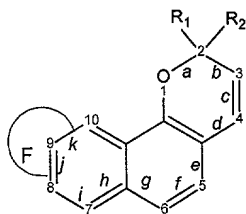
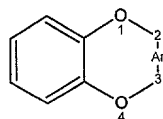


What is claimed is:

1. A photochromic naphthopyran having a central nucleus of the formula:



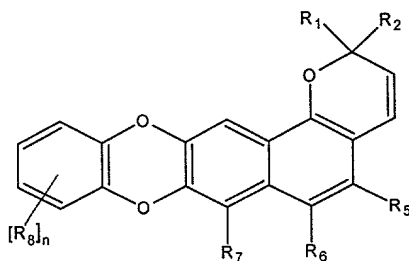
wherein F is a 1,4-benzodioxine ring having the following graphic formulae:



with its 2,3 positions fused to the *i*, *j*, or *k* side;

R_1 and R_2 are atoms or groups providing photochromic properties to the naphthopyran.

2. The photochromic naphthopyran of claim 1, characterized in that it has the following structure:



wherein,

R_1 and/or R_2 , independently represent optionally substituted aryl or heteroaryl groups the basic structure of which is selected from those of phenyl, naphthyl, biphenyl, pyridyl, furyl, benzofuryl, dibenzofuryl, N--(C_1 - C_6)alkylcarbazole, thienyl, benzothienyl, dibenzothienyl, julolidinyl groups; R_1 and/or R_2 advantageously representing a para-substituted phenyl group, said substituents are selected preferably from alkoxy, dialkylamino, diarylamino, or R_1 and R_2 together form an adamantyl group or norbornyl group or anthracenylidene

group; either R_1 or R_2 is mono- or di-substituted phenyl which is substituted in the position para to the connection side with $-\text{phenyl}$, $-(\text{CH}_2)_p\text{-phenyl}$ or $-\text{O}-(\text{CH}_2)_p\text{-phenyl}$ substituted, wherein p is an integer from 1 to 6, and the ring of the substituent group forms part of a second photochromic pyran;

R_5 and R_6 are the same or different, and may represent independently

a hydrogen,

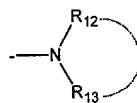
a linear or branched alkyl group that comprises 1 to 6 carbon atoms,

a $-\text{C}(\text{R}_{14})_2\text{X}$ group, wherein X is hydroxy, alkoxy, benzoyloxy, $\text{C}_1\text{-C}_6$ acyloxy, an amine or amide group: $-\text{NH}_2$, $-\text{NHR}_{12}$, $-\text{N}(\text{R}_{12})_2$, $-\text{CONH}_2$, $-\text{CONHR}_{12}$, $-\text{CON}(\text{R}_{11})_2$, R_{14} is hydrogen, $\text{C}_1\text{-C}_6$ alkyl, phenyl or naphthyl with $\text{C}_1\text{-C}_6$ alkyl or $\text{C}_1\text{-C}_6$ alkoxy substituents,

an optionally substituted phenyl or benzyl group,

a $-\text{COR}_{15}$, or $-\text{COOR}_{15}$ group, R_{15} representing a linear or branched alkyl group comprising 1 to 6 carbon atoms,

or alternatively, R_5 and R_6 may together form a 5- to 7-member optionally substituted carbocyclic or heterocyclic ring which can comprise at least one heteroatom selected from oxygen, sulfur, and nitrogen. The ring may be annelated with one aromatic group. Said substituents are selected from the group consisting of a C_1 to C_6 alkyl group which is linear or branched, a C_1 to C_6 alkoxy group which is linear or branched, and an amine group of formula



wherein R_{12} and R_{13} , which are the same or different, independently represent a hydrogen, a linear, branched, or cyclic alkyl group comprising 1 to 6 carbon atoms, an aryl or heteroaryl group, or representing, together with the nitrogen atom to which they are bound, a 5- to 7-membered ring which can comprise at least one other heteroatom selected from oxygen, sulfur and nitrogen, said nitrogen atom in the 5- to 7-membered ring being optionally substituted with an

R₁₀ group, which R₁₀ is a linear or branched alkyl group comprising 1 to 6 carbon atoms, a phenyl, a benzyl, or a naphthyl group.

R₇, and R₈ are independently

a hydrogen,

a linear or branched alkyl group which comprises 1 to 6 carbon atoms,

a cycloalkyl group comprising 3 to 7 carbon atoms,

a linear or branched alkoxy group comprising 1 to 6 carbon atoms,

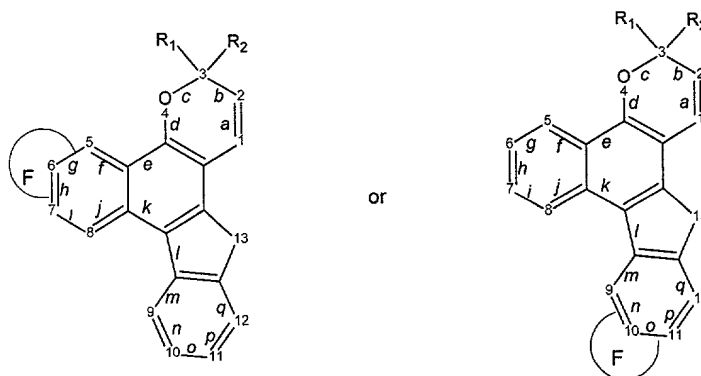
a haloalkyl, halocycloalkyl, or haloalkoxy group where alkyl groups comprise C₁ – C₆ alkyl groups, C₁ – C₆ haloalkoxy groups above respectively, which are substituted with at least one halogen atom, notably selected from fluorine, chlorine and bromine,

a linear or branched alkenyl or alkynyl group comprising 1-12 carbon

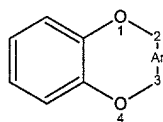
atoms, a linear or branched alkenoxy or alkynoxy group comprising 1-12 carbon atoms, and

n is an integer from 0 to 4.

3. A photochromic naphthopyran having a central nucleus of the formula



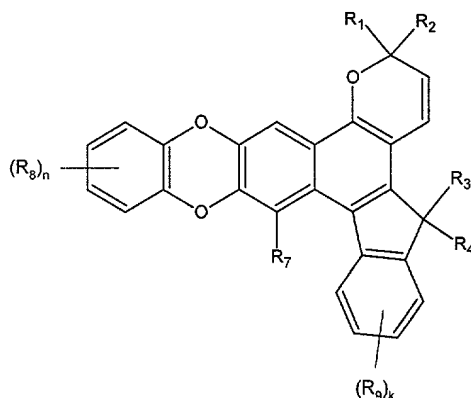
wherein F is a 1,4-benzodioxine ring having the following graphic formulae:



with its 2,3 positions fused to the *i, j, or k* side;

R_1 and R_2 are atoms or groups providing photochromic properties to the naphthopyran, and F, with its 2,3 positions, is fused to the *g, h, i, n, o, or p* side;

4. The photochromic naphthopyran of claim 3, characterized in that it has the following structure



wherein,

R_1 , R_2 , R_7 , and R_8 are as defined in Claim 2. R_9 independently represents groups as defined for R_8 . n and k are integers from 0 to 2;

R_3 and R_4 are the same or different, and may represent independently

a hydrogen, a hydroxy, a halogen,

a linear, branched, or cyclic alkyl group that comprises 1 to 6 carbon atoms,

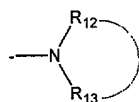
a $-OR_{20}$ group, wherein R_{20} is (C1-C3)alkyl, phenyl(C1-C3)alkyl, mono(C1-C3)alkylphenyl(C1-C3)alkyl, mono(C1-C3)alkoxyphenyl(C1-C3)alkyl, (C1-C3)alkoxy(C2-C4)alkyl, fluoro(C1-C3)alkyl, chloro(C1-C3)alkyl, or optionally substituted phenyl groups,

an optionally substituted aryl group, said substituents being mono, di-, or tri-, and selected from group R_{20} , and OR_{20} ,

a $-C(R_{14})_2X$ group, wherein X is hydroxy, alkoxy, benzoyloxy, C1-C6 acyloxy, an ester group: $-COOR_{11}$, an amine or amide group: $-NH_2$, $-NHR_{12}$, $-N(R_{12})_2$, $-CONH_2$, $-CONHR_{12}$, $-CON(R_{12})_2$, R_{14} is hydrogen, C1-C6 alkyl, phenyl or naphthyl with C1-C6 alkyl or C1-C6 alkoxy substituents,

a polyether or polyurea residue,

or R_3 and R_4 together form a 5- to 7-member optionally substituted spiro-cyclic ring which can comprise at least one heteroatom selected from oxygen, sulfur, and nitrogen, and may be annelated with one or two benzene groups, the substituents on said 5- to 7-member ring being



selected from the group consisting of a C1 to C6 alkyl group which is linear or branched, a C1 to C6 alkoxy group which is linear or branched, and an amine group of formula
wherein R_{12} and R_{13} are as defined in claim 2

5. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 1.

6. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 2.

7. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 3.

8. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 4.

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9. The photochromic naphthopyran of claim 1 wherein R_1 and R_2 are selected from the group consisting of hydrogen atoms, halogen atoms, and organic groups.

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10. The photochromic naphthopyran of claim 1 wherein R_1 and R_2 are selected from the group consisting of hydrogen atoms and organic groups.

11. The photochromic naphthopyran of claim 1 wherein R_1 and R_2 are selected from the group consisting of hydrogen atoms, aliphatic groups, aryl groups, and heterocyclic groups.

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12. The photochromic naphthopyran of claim 1 wherein R_1 and R_2 are selected from the group consisting of a) hydrogen atoms, b) a linear or branched alkyl group of 1 to 12 carbon atoms, c) a cycloalkyl group of 3 to 12 carbon atoms, d) an aryl group of 6 to 24 ring carbon atoms, e) a heteroaryl group of 4 to 24 carbon atoms and at least one hetero ring atom selected from sulfur, oxygen and nitrogen; and f) wherein R_1 and R_2 together form a heterocyclic ring.

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13. The photochromic naphthopyran of claim 9 wherein the heterocyclic ring formed from R_1 and R_2 is selected from the group consisting of an adamantyl, norbornyl, fluorenylidene, di(C_1 - C_6)alkylanthracenyliidene and spiro(C_5 - C_6)cycloalkylanthracenyliidene group.

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14. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 9.

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15. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 10.

5 16. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 11.

10 17. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 12.

15 18. A photochromic article comprising a light permeable matrix having applied thereto or dispersed or diffused therein a photochromic amount of a photochromic naphthopyran according to claim 13.

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